

<u>4189511</u>	February 1980	Levers et al.	N/A
<u>4435239</u>	March 1984	Harris	N/A
<u>4468845</u>	September 1984	Harris	N/A
<u>5509430</u>	April 1996	Berger	N/A
<u>5672419</u>	September 1997	Mukaida et al.	N/A

**OTHER  
PUBLICATIONS**

"Encyclopedia of Polymer Science and Engineering," vol. 6,  
John Wiley & Sons (New York), p. 830-831, (1986). cited by  
other

"Encyclopedia of Polymer Science and Engineering," vol. 10,  
John Wiley & Sons (New York), p. 204-253, (1987). cited by  
other

S. P. Hersh, Polyblend **Fibers**, "High Technology **Fibers**,"  
Marcel Dekker, Inc. (New York), p. 1-47, (1985). cited by other

**ART-UNIT:** 1771  
**PRIMARY-EXAMINER:** Torres; Norca  
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*File 4. 212*

**ABSTRACT:**

The invention is directed to a nonwoven material made of a **bicomponent fiber** in which the first polymer is a cellulose ester polymer, preferably cellulose acetate, and the second polymer is selected from the group consisting of polyolefins, polyesters, **polyamides** and polyimides. The **bicomponent fiber** can be either a side-by-side or a **core-and-sheath fibers**. When **core-and-sheath**, the cellulose acetate is the **sheath** polymer. The nonwoven material of the invention can be used to prepare grips, materials for use in absorbent products such as diapers and personal hygiene products, disposable towels and other products. The nonwoven of the invention has particular utility for disposable diaper products due to the superior fluid acquisition, retention and distribution properties of the cellulose ester, yet avoids the high cost of all cellulose acetate **fibers** by use of a much less expensive second polymer to form part the **bicomponent fiber**.

24 Claims, 0 Drawing figures

**Abstract Text - ABTX (1):**

The invention is directed to a nonwoven material made of a **bicomponent fiber** in which the first polymer is a cellulose ester polymer, preferably cellulose acetate, and the second polymer is selected from the group consisting of polyolefins, polyesters, **polyamides** and polyimides. The **bicomponent fiber** can be either a side-by-side or a **core-and -sheath fibers**. When **core-and -sheath**, the cellulose acetate is the **sheath** polymer. The nonwoven material of the invention can be used to prepare grips, materials for use in absorbent products such as diapers and personal hygiene products, disposable towels and other products. The nonwoven of the invention has particular utility for disposable diaper products due to the superior fluid acquisition, retention and distribution properties of the cellulose ester, yet avoids the high cost of all cellulose acetate **fibers** by use of a much less expensive second polymer to form part the **bicomponent fiber**.

**US Patent No. - PN (1):**

**7081423**

**TITLE - TI (1):**

Nonwoven absorbent materials made with cellulose ester containing **bicomponent fibers**

**Brief Summary Text - BSTX (2):**

The invention relates to nonwoven materials made using a cellulose acetate containing **bicomponent fiber**. In particular, the invention relates to nonwoven materials for use in absorbent products, wherein the nonwoven material is formed by any method known in the art from a **bicomponent fiber** comprising a cellulose ester as a first polymer material and a second polymer material of different chemical nature.

**Brief Summary Text - BSTX (4):**

**Bicomponent fibers** are known in the art, and such **bicomponent fibers**, as the term is used herein, comprise two polymer materials of different chemical nature which are combined in some fashion such that each of the two polymers is discretely identifiable in a particular portion of the overall **fiber** structure. Examples include **core-and -sheath fibers**, side-by-side **fibers**, and island-in-the-sea **fiber** among others. While such **bicomponent fibers** are generally made of combinations of polyesters, **polyamides**,

polyamides, liquid crystalline polymers and others polymeric materials, at least one bicomponent fiber has been described which comprises cellulose acetate and a second polymer material.

**Brief Summary Text - BSTX (5):**

U.S. Pat. No. 5,509,430 to Berger describes a core-and -sheath type bicomponent fiber in which a sheath of cellulose acetate surrounds a core of polypropylene. The bicomponent fiber is used to prepare tobacco smoke filter rods for use in cigarettes and other smoking products. Although cellulose acetate is an expensive material relative to other polymers such as polypropylene, it is used in such filters because its cost is offset by other factors such as having an acceptable filter efficiency, not significantly detracting from taste, having low resistance to draw and having sufficient, but not excessive, hardness.

**Brief Summary Text - BSTX (6):**

Nonwoven products are also known in the art and such products have been made from many different materials including natural cellulose (e.g., wood pulp and cotton), polyolefins, polyesters and other polymeric materials. Examples of such products include disposable towels, diapers and other hygiene products. Since such nonwoven products are usually disposable, cellulose esters have not generally been used because of the cost of the cellulose ester material. For similar reasons related to the cost of the cellulose esters, bicomponent fibers having a cellulose ester sheath have not been prepared and used in such products. Lastly, because cellulose ester fibers are generally of low strength relative to other fibers such as polyolefins and polyesters, the cellulose ester fibers often cannot be used on high speed manufacturing machines because they undergo excessive breakage resulting in manufacturing downtime. However, because cellulose esters have certain desirable properties, particularly with regard to fluid acquisition and absorption, and the ability wick fluids from one site to another, cellulose ester fibers and cellulose ester sheathed bicomponent fibers present unique opportunities in the preparation of nonwoven materials.

**Brief Summary Text - BSTX (7):**

Accordingly, one purpose of this invention is to describe nonwoven materials and methods of preparing same which utilize bicomponent fibers comprising a first cellulose ester polymer and a second, different polymer.

**Brief Summary Text - BSTX (8):**

*Claw 1*

Another purpose of this invention is to describe nonwoven materials and methods of preparing same which utilize core-and -sheath bicomponent fibers having a sheath of a first cellulose ester polymer and a core of a second, different polymer.

#### **Brief Summary Text - BSTX (9):**

In addition, it is also the purpose of this invention to describe absorbent products made of nonwoven materials which have improved fluid acquisition, distribution and retention properties due to the utilization of a bicomponent fiber comprising a first cellulose ester polymer and a second, different polymer.

#### **Brief Summary Text - BSTX (11):**

The present invention is directed to a nonwoven material prepared using a core-and -sheath or side-by-side bicomponent fiber comprising a first plasticized or un-plasticized cellulose ester polymer and a second different polymer material. The resulting bicomponent fibers may be used as a single filaments, a tow of a plurality of filaments, or as a staple or short fiber made from such bicomponent fibers. The bicomponent fibers can have any cross-section characteristics, for example, round, Y- or X-shaped, trilobal and similar shapes known in the art. The only restriction on the selected form of the bicomponent fiber is that the cellulose ester part of the bicomponent fiber be accessible to fluids such as air, water and other liquids.

#### **Description Paragraph - DETX (2):**

The teachings of all patents and publications cited herein are incorporated herein by reference. All percentages are weight percentages (wt. %) unless specified otherwise.

#### **Description Paragraph - DETX (3):**

The term "bicomponent fiber" as used herein means a fiber made of two polymer materials of different chemical nature which are combined in some fashion such that each of the two polymers is discretely identifiable in a particular portion of the overall fiber structure, and the term is inclusive of filaments, staple and short fiber products. While many forms of bicomponent fibers are possible, the preferred forms for use in the instant invention are core-and -sheath ("core/sheath") and side-by-side ("side/side") bicomponent fibers. The only restriction on the selected form is that the cellulose ester part of the bicomponent fiber be accessible to fluids such as air, water and other liquids. Consequently, any bicomponent fiber in which the cellulose ester is covered or masked by the second polymer, and thus not accessible to air, water or other liquids, is excluded. The bicomponent fiber can be of any cross-section shape, for example, round, X- or Y-shaped, trilobal, elliptical, and any similar shape which can be prepared. Preferred forms

are those which have a high surface area so as to maximize the fluid adsorption, retention and transport properties of the cellulose ester.

#### Description Paragraph - DETX (4):

The cellulose ester polymer (the "first polymer component") used in preparing the bicomponent fiber used in practicing the invention can be any cellulose ester formed by the esterification of cellulose, which has three hydroxyl groups per .beta.(1.fwdarw.anhydroglucose ring, with a C.sub.2 C.sub.8 alkyl carboxylic acid. C.sub.2 C.sub.4 carboxylic acids are preferred. The preferred cellulose ester is cellulose acetate having a Degree of Substitution (DS) in the range of about 1.5 to about 3.0, and preferably in the range of about 1.7 to about 2.6. DS refers to the average number of the cellulose anhydroglucose ring hydroxyl group hydrogen atoms which have been replaced by the carboxylate moiety. There are three such hydroxyl groups per ring. The cellulose ester polymer can be used without or with additives such as plasticizers, colorants, lubricants and similar additives known to those skilled in the art.

#### Description Paragraph - DETX (6):

The second polymer component used in preparing the bicomponent fiber used in practicing the invention can be any polymer selected from the group consisting of polyolefins (for example, polyethylene and polypropylene), polyester (for example, polyethylene terephthalate and polytrimethylene terephthalate) and polyamides (for example, nylon 66). Preferred second component polymers are polypropylene and polyethylene terephthalate. The second polymer component can be used without or with additives such as plasticizers, colorants, lubricants and similar additives known to those skilled in the art.

#### Description Paragraph - DETX (7):

The diameter of the of the bicomponent fiber used in practicing the invention can be any diameter suitable for the preparation of nonwoven materials. The diameter can range is from about 1 to about 50 microns, with a preferred range of about 1 to about 20 microns, and a most preferred range of about 1 to about 10 microns. For non-round bicomponent fibers, for example, trilobal or X-shaped fibers, the diameter is measured across a circle circumscribing the outer edges of the fiber, for example, .

#### Description Paragraph - DETX (8):

The bicomponent fibers used in practicing the invention can be prepared by any method known in the art suitable for preparing bicomponent fibers and such methods are not part of the invention. For example, the bicomponent fiber can be prepared by melt extrusion of the first and second polymer components, or by first extruding or

solution spinning the second polymer component followed by immersing, once or a plurality of times, the resulting second polymer component fiber in a cellulose ester solution or melt to thereby coat the second polymer fiber with the cellulose ester. Methods of preparing bicomponent fibers have been described in the Berger patent cited above; in the Encyclopedia of Polymer Science and Engineering, Volume 6 (New York, Wiley-Interscience, 1987), pages 830 831, and citations given therein; in S. P. Hersh, "Polyblend Fibers," High Fiber Technology, Part A (New York, Marcel Dekker, 1985), pages 1 47, and in U.S. Pat. No. 4,189,511 to Levers et al. (coating a polypropylene core with an acetone dope of cellulose acetate to prepare a cigarette tow having a cellulose sheath; incorporated herein by reference). The bicomponent fibers can be used in continuous fiber form, for example, as a tow of fibers, to form a nonwoven material or they can be cut into staple or short fibers and formed into a nonwoven material by conventional methods. The bicomponent fibers used in practicing the invention are 10 90% core material and 90 10% sheath (e.g., cellulose acetate) material. The preferred bicomponent fibers being about 50 to about 90% core material and about 10 to about 50% sheath material (e.g. cellulose acetate) to minimize cost.

#### **Description Paragraph - DETX (9):**

Subsequent to preparing the bicomponent fiber, the fiber is made into a nonwoven material by any method known in the art. Methods of preparing nonwoven material are described in the Encyclopedia of Polymer Science and Engineering, Volume 10, (New York, Wiley-Interscience, 1987), pages 204 253 and citations given therein. Continuous bicomponent fibers can be formed into a nonwoven material immediately after formation, for example, by the spunbond process after melt extrusion (ibid., page 214). A plurality of individual bicomponent fibers can also be combined to form a "tow" of fibers, with or without crimping, though preferably with crimping, which can then be opened and formed into a nonwoven material using either threaded rollers or an air jet as described in U.S. Pat. Nos. 4,435,239 and 4,468,845. Staple and short fibers can be formed into nonwoven materials by conventional methods, for example, carding, air-laying, wet-forming and dry-forming.

#### **Description Paragraph - DETX (10):**

Various substances (for example, superabsorbent polymers (SAP), adhesives, fibrous pulp, charcoal, talc, and other substances known in the art as being added to nonwoven materials) can be added to the nonwoven material either during formation or afterwards. For example, during wet-forming with short bicomponent fibers, a superabsorbent polymer (SAP) can be added to the forming solution before forming. The formed, SAP-containing nonwoven is then dried and subsequently used to make absorbent products. In continuous nonwoven formation using a melt extruded bicomponent fiber, SAP, wood

pulp and similar substances known in the art can be applied or added to the nonwoven as it is laid down. Typical application methods include gravity feeding and air blowing after lay-down, with or without vibration of the nonwoven, to distribute the applied material throughout the nonwoven structure. These same substance application methods can be used with nonwoven materials formed from a tow of fibers using threaded rollers or air jets.

#### **Description Paragraph - DETX (12):**

A bicomponent fiber of round cross section having a polypropylene (PP) core and a plasticized cellulose acetate (CA) sheath is prepared by melt extrusion and is continuously laid down to form a nonwoven material. The fiber is 50/50 wt. % PP/CA. Subsequent to lay-down, SAP is gravity fed onto the nonwoven which is then vibrated to distribute the SAP throughout the nonwoven structure. The SAP-containing nonwoven is then fed to a diaper making apparatus to be formed into a diaper. The resulting diaper is found to have better fluid acquisition, distribution and retention properties than conventional diapers, thereby preventing leakage and minimizing fluid/skin contact time.

#### **Description Paragraph - DETX (13):**

If the nonwoven is to be used as a self-adhesive grip material, subsequent to lay-down the bicomponent fibers may optionally be entangled by needle-punching or hydroentangling, an adhesive applied on one face nonwoven, and a removable cover sheet may be placed over the adhesive. The resulting self-adhesive nonwoven is then cut to size, packaged and sold as a grip for use on sports equipment, tools, and similar application requiring grips. The advantage of the grip is that the CA sheath material wicks moisture away from the surface of the grip thereby providing less slippage than conventional grips.

#### **Description Paragraph - DETX (15):**

A polyethylene terephthalate (PET) fiber having a trilobal or X-shaped cross section is melt spun by conventional methods or is purchased commercially. The PET fiber is passed through a cellulose acetate/acetone solution (about 6 to about 30 wt. % CA; no plasticizer) followed by solvent removal, for example, by evaporation in a warmed (35 to 75.degree. C.) atmosphere or application of a warmed air stream). If necessary, the CA acquisition and solvent removal steps is repeated a plurality times until the desired amount of CA has been acquired. Subsequent to acquisition of CA, the resulting bicomponent fiber is laid down to form a nonwoven material. If desired, the final drying step can be eliminated and the "wet" CA/PET fiber laid down, followed by subsequent drying. This procedure promotes inter -fiber bonding in the nonwoven material and may minimize or eliminate the need to the use entangling methods, for example, needle-punching or hydroentangling. Wood pulp is then applied to nonwoven material which is

then vibrated to distribute the pulp throughout the structure. The resulting wood pulp containing nonwoven is then fed to a diaper making machine for formation into diapers.

#### **Description Paragraph - DETX (16):**

Solvents suitable for use in preparing the CA solution or dope, in addition to acetone, include methyl ethyl ketone and higher aliphatic ketones, methylene dichloride and other chlorinated hydrocarbons, dimethyl sulfoxide, tetrahydrofuran and other solvents known in the art to dissolve CA. The concentration of CA in the dope or solution may be from about 3 to about 40 wt %, preferably about 6 to about 30 wt. %. When using this procedure, caution should be taken regarding the combination of solvent and core fiber to avoid dissolving the core fiber or overly tackfying it. Problems can be avoided by adjusting the contact time, evaporating temperatures and other processing parameters. The CA/PET nonwoven material can also be used to prepare "wet wipe" type towels, grips, shoe and boot inserts, and similar products.

#### **Description Paragraph - DETX (18):**

A CA/PP bicomponent fiber is prepared as in Example 1. The resulting fiber is then cut or chopped into a staple fiber which is used to prepare an air-laid nonwoven material using known procedures. The resulting nonwoven material is used to prepare disposable towels.

#### **Description Paragraph - DETX (20):**

A bicomponent fiber of round cross section having a polypropylene (PP) core and a plasticized cellulose acetate (CA) sheath is prepared by melt blown extrusion, and is continuously laid down to form a non-woven material. The fiber is 50/50 wt. % PP/CA. Melt blowing technology used for bicomponent fibers is well known, and is described, for example, in U.S. Pat. No. 5,509,430 to Berger. Subsequent to lay-down, SAP is gravity fed onto the non-woven, which is then vibrated to distribute the SAP throughout the non-woven structure. The SAP-containing non-woven is then fed to a diaper making apparatus to be formed into a diaper. The resulting diaper is found to have better fluid acquisition, distribution and retention properties than conventional diapers, thereby preventing leakage and minimizing fluid/skin contact time.

#### **Description Paragraph - DETX (22):**

A CA/PP bicomponent fiber is prepared as in Example 4. The resulting fiber is then cut or chopped, and used to prepare an air-laid non-woven material using known procedures. The resulting non-woven material is used to prepare disposable towels.

#### **Description Paragraph - DETX (24):**



A 50/50 wt. % CA/PP **bicomponent fibers** is prepared and laid down using the spunbond process to form a nonwoven material. SAP is gravity fed as described in Example 1 and the resulting SAP-containing nonwoven material is used to prepare diapers.

**Claims Text - CLTX (1):**

1. A method for the production of a nonwoven product comprising the steps of: providing a nonwoven material having a **bicomponent fiber** of a cellulose ester polymer and a second polymer selected from the group consisting of polyolefins, polyesters, **polyamides**, and polyimides; where said **bicomponent fiber** is either a **core-and -sheath fiber** or a side-by-side **fiber**; forming a nonwoven product from said nonwoven material where said nonwoven product is selected from the group consisting of: disposable towels; diapers; hygienic products; grips; "wet wipe" type towels; and inserts for shoes and boots.

**Claims Text - CLTX (2):**

2. The method of claim 1 wherein said **bicomponent fiber being said core-and -sheath fiber**.

**Claims Text - CLTX (3):**

3. The method of claim 2 wherein said **cellulose ester polymer** comprising said **sheath of said bicomponent fiber**.

**Claims Text - CLTX (4):**

4. The method of claim 1 wherein said **bicomponent fiber** comprises about 10 to about 90 weight percent of said cellulose ester polymer and about 90 to about 10 weight percent of said **second polymer**.

**Claims Text - CLTX (5):**

5. The method of claim 4 wherein said **bicomponent fiber** comprises about 10 to about 50 weight percent cellulose ester polymer and about 50 to about 90 weight percent of said second polymer.

**Claims Text - CLTX (6):**

6. The method of claim 1 wherein said **bicomponent fiber** having a diameter in the range of about 1 to about 50 microns.

**Claims Text - CLTX (7):**

7. The method of claim 6 wherein said bicomponent fiber having a diameter in the range of about 1 to about 20 microns.

**Claims Text - CLTX (9):**

9. The method of claim 1 wherein said bicomponent fiber being a staple fiber.

**Claims Text - CLTX (12):**

12. The method of claim 1 wherein said bicomponent fiber comprising about 10 to 50 weight percent cellulose acetate polymer sheath and about 50 to 90 weight percent polypropylene core.

**Claims Text - CLTX (13):**

13. A method of absorbing a liquid comprising the steps of: providing a nonwoven material having a bicomponent fiber of a cellulose ester polymer and a second polymer selected from the group consisting of polyolefins, polyesters, polyamides, and polyimides; wherein said bicomponent fiber being either a core-and -sheath fiber or a side-by-side fiber where said nonwoven material is in a form of a nonwoven product, said nonwoven product is selected from the group consisting of: disposable towels; diapers; hygienic products; grips; "wet wipe" type towels; and inserts for shoes and boots; providing a liquid; and contacting said liquid with said nonwoven material where said nonwoven material absorbs said liquid.

**Claims Text - CLTX (14):**

14. The method of claim 13 wherein said bicomponent fiber being said core-and -sheath fiber.

**Claims Text - CLTX (15):**

15. The method of claim 14 wherein said cellulose ester polymer comprising said sheath of said bicomponent fiber.

**Claims Text - CLTX (16):**

16. The method of claim 13 wherein said bicomponent fiber comprises about 10 to about 90 weight percent of said cellulose ester polymer and about 90 to about 10 weight percent of said second polymer.

**Claims Text - CLTX (17):**

17. The method of claim 16 wherein said **bicomponent fiber** comprises about 10 to about 50 weight percent cellulose ester polymer and about 50 to about 90 weight percent of said second polymer.

**Claims Text - CLTX (18):**

18. The method of claim 13 wherein said **bicomponent fiber** having a diameter in the range of about 1 to about 50 microns.

**Claims Text - CLTX (19):**

19. The method of claim 18 wherein said **bicomponent fiber** having a diameter in the range of about 1 to about 20 microns.

**Claims Text - CLTX (21):**

21. The method of claim 13 wherein said **bicomponent fiber** being a staple **fiber**.

**Claims Text - CLTX (24):**

24. The method of claim 13 wherein said **bicomponent fiber** comprising about 10 to 50 weight percent cellulose acetate polymer **sheath** and about 50 to 90 weight percent polypropylene **core**.

**Other Reference Publication - OREF (3):**

S. P. Hersh, Polyblend **Fibers**, "High Technology **Fibers**," Marcel Dekker, Inc. (New York), p. 1-47, (1985). cited by other

**US-PAT-NO:** **6686303**

**DOCUMENT-  
IDENTIFIER:** US 6686303 B1

**TITLE:** **Bicomponent** nonwoven webs containing splittable thermoplastic filaments and a third **component**

**DATE-ISSUED:** February 3, 2004

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**INT-CL-CURRENT:**

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CIPS	<u>D01 F 8/12</u> 20060101
CIPS	<u>D01 F 8/14</u> 20060101
CIPS	<u>D01 F 8/06</u> 20060101
CIPS	<u>D04 H 1/54</u> 20060101

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**\*\*See application file for complete search history\*\***

**REF-CITED:**

**U.S. PATENT DOCUMENTS**

<b>PAT-NO</b>	<b>ISSUE-DATE</b>	<b>PATENTEE-NAME</b>	<b>US-CL</b>
<u>3338992</u>	August 1967	Kinney	264/24 N/A N/A
<u>3341394</u>	September 1967	Kinney	161/72 N/A N/A
<u>3485706</u>	December 1969	Evans	161/72 N/A N/A

<u>3502538</u>	March 1970	Petersen	161/150	N/A N/A
<u>3502763</u>	March 1970	Hartmann	264/210	N/A N/A
<u>3542615</u>	November 1970	Dobo et al.	156/181	N/A N/A
<u>3692618</u>	September 1972	Dorschner et al.	161/72	N/A N/A
<u>3802817</u>	April 1974	Matsuki et al.	425/66	N/A N/A
<u>3849241</u>	November 1974	Butin et al.	161/169	N/A N/A
<u>3855046</u>	December 1974	Hansen et al.	161/150	N/A N/A
<u>3901236</u>	August 1975	Assarsson et al.	128/284	N/A N/A
<u>3966865</u>	June 1976	Nishida et al.	264/147	N/A N/A
<u>4076663</u>	February 1978	Masuda et al.	260/17.4GC	N/A N/A
<u>4100324</u>	July 1978	Anderson et al.	428/288	N/A N/A
<u>4286082</u>	August 1981	Tsubakimoto et al.	526/240	N/A N/A
<u>4340563</u>	July 1982	Appel et al.	264/518	N/A N/A
<u>4369156</u>	January 1983	Mathes et al.	264/147	N/A N/A
<u>4530353</u>	July 1985	Lauritzen	128/156	N/A N/A
<u>4547420</u>	October 1985	Krueger et al.	428/229	N/A N/A
<u>4588630</u>	May 1986	Shimalla	428/131	N/A N/A
<u>4663220</u>	May 1987	Wisneski et al.	428/221	N/A N/A
<u>4729371</u>	March 1988	Krueger et al.	128/206.19	N/A N/A
<u>4767825</u>	August 1988	Pazos et al.	525/408	N/A N/A
<u>4795668</u>	January 1989	Krueger et al.	428/174	N/A N/A
<u>4818464</u>	April 1989	Lau	264/510	N/A N/A
<u>4902559</u>	February 1990	Eschwey et al.	N/A	N/A N/A
<u>4923914</u>	May 1990	Nohr et al.	524/99	N/A N/A
<u>5057166</u>	October 1991	Young, Sr. et al.	156/62.2	N/A N/A
<u>5064689</u>	November 1991	Young, Sr. et al.	427/202	N/A N/A
<u>5108820</u>	April 1992	Kaneko et al.	428/198	N/A N/A
<u>5147343</u>	September 1992	Kellenberger	604/368	N/A N/A
<u>5225014</u>	July 1993	Ogata et al.	156/73.2	N/A N/A
<u>5230959</u>	July 1993	Young, Sr. et al.	428/372	N/A N/A
<u>5290626</u>	March 1994	Nishioi et al.	428/224	N/A N/A
<u>5302447</u>	April 1994	Ogata et al.	428/288	N/A N/A

<u>5336552</u>	August 1994	Strack et al.	428/224	N/A N/A
<u>5372885</u>	December 1994	Tabor et al.	428/373	N/A N/A
<u>5382400</u>	January 1995	Pike et al.	264/168	N/A N/A
<u>5424115</u>	June 1995	Stokes	428/198	N/A N/A
<u>5432000</u>	July 1995	Young, Sr. et al.	428/372	N/A N/A
<u>5511960</u>	April 1996	Terakawa et al.	425/7	N/A N/A
<u>5516585</u>	May 1996	Young, Sr. et al.	428/372	N/A N/A
<u>5670044</u>	September 1997	Ogata et al.	210/497.01	N/A N/A
<u>5672419</u>	September 1997	Mukaida et al.	428/283	N/A N/A
<u>5679042</u>	October 1997	Varona	442/347	N/A N/A
<u>5681305</u>	October 1997	Korpman	604/390	N/A N/A
<u>5695376</u>	December 1997	Datta et al.	442/334	N/A N/A
<u>5733822</u>	March 1998	Gessner et al.	442/35	N/A N/A
<u>5759926</u>	June 1998	Pike et al.	442/333	N/A N/A
<u>5866488</u>	February 1999	Terada et al.	442/362	N/A N/A
<u>5981410</u>	November 1999	Hansen et al.	442/361	N/A N/A
<u>5994615</u>	November 1999	Dodge, II et al.	604/378	N/A N/A
<u>6022818</u>	February 2000	Welchel et al.	N/A	N/A N/A
<u>6048808</u>	April 2000	Kurihara et al.	442/361	N/A N/A
<u>6118041</u>	September 2000	Roe et al.	604/360	N/A N/A
<u>6120488</u>	September 2000	Vanrijswijck et al.	604/385.28	N/A N/A
<u>6120783</u>	September 2000	Roe et al.	424/402	N/A N/A
<u>6142985</u>	November 2000	Feist et al.	604/385.29	N/A N/A

## FOREIGN PATENT DOCUMENTS

### FOREIGN-PAT-NO PUBN-DATE COUNTRY US-CL

0 216 520	August 1986	EP
4065568	March 1992	JP
7138866	May 1995	JP
98/03710	January 1998	WO
WO 98/45519	October 1998	WO

**OTHER  
PUBLICATIONS**

J.M.G.. Cowie: Polymers: Chemistry and Physics of Modern  
Materials, 142-145, International Textbook Co., Ltd., 1973.

**ART-UNIT:**

1771

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**ASSISTANT-EXAMINER:** Pratt; Christopher C.

**ATTY-AGENT-FIRM:** Pauley Peterson & Erickson

**ABSTRACT:**

An improved nonwoven web composite is formed by combining splittable **bicomponent** thermoplastic filaments with a **component** selected from other **fibers** and particles. The **bicomponent** filaments include distinct regions of first and second incompatible polymers extending the length of the filaments. After the **bicomponent** filaments are combined with the other **fibers** and/or particles, the **bicomponent** filaments are caused to split lengthwise along boundaries between the regions of different polymers, resulting in a web or matrix of finer filaments which entrap, ensnare and contain the other **fibers** and/or particles within the web or matrix. The nonwoven web composite is particularly useful for making absorbent articles, which require durability and optimum levels of absorbent **fibers** and/or particles.

24 Claims, 0 Drawing figures

Exemplary Claim Number: 1

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**Abstract Text - ABTX (1):**

An improved nonwoven web composite is formed by combining splittable **bicomponent** thermoplastic filaments with a **component** selected from other **fibers** and particles. The **bicomponent** filaments include distinct regions of first and second incompatible polymers extending the length of the filaments. After the **bicomponent** filaments are combined with the other **fibers** and/or particles, the **bicomponent** filaments are caused to split lengthwise along boundaries between the regions of different polymers, resulting in a web or matrix of finer filaments which entrap, ensnare and contain the other **fibers** and/or particles within the web or matrix. The nonwoven web



composite is particularly useful for making absorbent articles, which require durability and optimum levels of absorbent fibers and/or particles.

**US Patent No. - PN (1):**

6686303

**TITLE - TI (1):**

Bicomponent nonwoven webs containing splittable thermoplastic filaments and a third component

**Brief Summary Text - BSTX (2):**

This invention relates to bicomponent nonwoven webs containing splittable thermoplastic filaments and a third component selected from fibers, particles and combinations thereof. The splitting of bicomponent filaments into smaller filaments helps to contain the third component, and may add softness to the composite product. Also, better capillary may result from the increased filament surface area.

**Brief Summary Text - BSTX (4):**

Bicomponent nonwoven filaments are known in the art generally as thermoplastic filaments which employ at least two different polymers combined together in a heterogeneous fashion. Instead of being homogeneously blended, two polymers may, for instance, be combined in a side-by-side configuration, so that a first side of a filament is composed of a first polymer "A" and a second side of the filament is composed of a second polymer "B." Alternatively, the polymers may be combined in a sheath-core configuration, so that an outer sheath layer of a filament is composed of a first polymer "A," and the inner core is composed of a second polymer "B." Alternatively, the polymers may be combined in an islands-in-the-sea configuration in which one or more islands of a first polymer "A" appear in a sea of a second polymer "B." Other heterogeneous configurations are also possible.

**Brief Summary Text - BSTX (5):**

Splittable nonwoven bicomponent filaments are disclosed in U.S. Pat. No. 5,759,926, issued to Pike et al. These filaments contain at least two incompatible polymers arranged in distinct segments across the cross-section of each filament. The incompatible segments are continuous along the length of each filament. The individual segments of each filament split apart from each other when the filament is contacted with a hot aqueous fibrillation-inducing medium, resulting in finer individual filaments formed from the segments. Other techniques for splitting bicomponent filaments include

mechanical agitation and spontaneous splitting caused by differential shrinkage of the components.

**Brief Summary Text - BSTX (6):**

Bicomponent filaments have been disclosed in combination with carbon particles, zeolites, ion exchange resins, carbon fibers, stabilizing fibers, and/or gas absorbing fibers for use in specialized filters. U.S. Pat. No. 5,670,044, issued to Ogata et al., discloses the use of bicomponent meltblown filaments in these combinations, for use in cylindrical filters. In that case, the bicomponent filaments contain high and low melting polymers. The filaments of the filter are stacked and bonded together by melting only the lower melting component. However, Ogata et al. does not suggest splitting the bicomponent filaments.

**Brief Summary Text - BSTX (7):**

Pulp fibers have been employed in certain absorbent applications, to enhance the absorbency. U.S. Pat. No. 4,530,353, issued to Lauritzen, discloses pulp fibers in combination with staple length bicomponent fibers used in the manufacture of absorbent bandages. In that case, the fibers also contain high and low melting polymers. The staple length fibers are bonded together by melting only the lower melting component. Again, there is no suggestion to split the bicomponent filaments.

**Brief Summary Text - BSTX (8):**

In the field of absorbent articles, and other fields where thermoplastic nonwoven webs are combined with a third component selected from other fibers and/or particles, there is a need or desire for techniques which better contain the third component within the thermoplastic nonwoven filaments. There is also a need or desire for techniques which increase the maximum amount of the third component that can be ensnared, entangled, or otherwise contained within the matrix of thermoplastic nonwoven filaments.

**Brief Summary Text - BSTX (10):**

The present invention is directed to an improved nonwoven composite wherein thermoplastic nonwoven filaments are utilized as a matrix for ensnaring, containing and restraining a component selected from other fibers and/or particles. The nonwoven composite provides improved containment of the other fibers and/or particles, and effectively contains higher levels of the other fibers and/or particles within a thermoplastic nonwoven filament matrix. The improved performance is accomplished using splittable thermoplastic bicomponent filaments, whose first and second polymers split apart into a larger number of finer filaments. The resulting finer filaments, in the

increased number, provide better containment of the third component selected from other fibers and/or particles.

**Brief Summary Text - BSTX (12):**

The splittable bicomponent filaments contain at least first and second mutually incompatible thermoplastic polymer components, arranged in distinct segments across the width of the filament. Each polymer component is preferably continuous along the length of each splittable filament. Preferably, the splitting of the segments is controllable, so that the third component (other pulp or particles) can be combined relatively easily with the bicomponent filaments before they are split. Thereafter, the bicomponent filaments are responsive to a control mechanism which induces splitting of the filaments into finer filaments corresponding to each segment, to more firmly entrap and ensnare the third component within the matrix of thermoplastic filaments. Preferably, the splittable bicomponent filaments, and the thermoplastic segment components thereof, are substantially continuous in length.

**Brief Summary Text - BSTX (13):**

With the foregoing in mind, it is a feature and advantage of the invention to provide an improved nonwoven web composite which exhibits improved containment of a third component selected from fibers and/or particles, within a matrix of thermoplastic nonwoven filaments.

**Brief Summary Text - BSTX (14):**

It is also a feature and advantage of the invention to provide a nonwoven web composite having a latent controlled containment mechanism, which improves the ensnaring and entrapment of the third component after the third component enters the thermoplastic filament matrix.

**Brief Summary Text - BSTX (17):**

The term "nonwoven fabric or web" means a web having a structure of individual fibers or threads which are interlaid, but not in a regular or identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes such as, for example, meltblowing processes, spunbonding processes, air laying processes, and bonded carded web processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91.)

**Brief Summary Text - BSTX (18):**

The term "microfibers" means small diameter fibers having an average diameter not greater than about 75 microns, for example, having an average diameter of from about 1 micron to about 50 microns, or more particularly, microfibers may have an average diameter of from about 1 micron to about 30 microns. Another frequently used expression of fiber diameter is denier, which is defined as grams per 9000 meters of a fiber. For a fiber having circular cross-section, denier may be calculated as fiber diameter in microns squared, multiplied by the density in grams/cc, multiplied by 0.00707. A lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. For example, the diameter of a polypropylene fiber given as 15 microns may be converted to denier by squaring, multiplying the result by 0.89 g/cc and multiplying by 0.00707. Thus, a 15 micron polypropylene fiber has a denier of about 1.42 ( $15 \times 15 \times 0.89 \times 0.00707 = 1.415$ ). Outside the United States the unit of measurement is more commonly the "tex," which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9. The foregoing range refers to diameters existing before any splitting. The splitting of bicomponent microfibers would result in correspondingly smaller diameters.

#### **Brief Summary Text - BSTX (19):**

The term "spunbonded fibers" refers to small diameter fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine capillaries of a spinnerette having a circular or other configuration, with the diameter of the extruded filaments then being rapidly reduced as by, for example, in U.S. Pat. No. 4,340,563 to Appel et al., and U.S. Pat. No. 3,692,618 to Dorschner et al., U.S. Pat. No. 3,802,817 to Matsuki et al., U.S. Pat. Nos. 3,338,992 and 3,341,394 to Kinney, U.S. Pat. No. 3,502,763 to Hartman, U.S. Pat. No. 3,502,538 to Petersen, and U.S. Pat. No. 3,542,615 to Dobo et al., each of which is incorporated herein in its entirety by reference. Spunbond fibers are quenched and generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and often have average diameters larger than about 7 microns, more particularly, between about 10 and 30 microns. Again, the splitting of bicomponent spunbonded fibers would result in correspondingly smaller diameters.

#### **Brief Summary Text - BSTX (20):**

The term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity heated gas (e.g., air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed for example, in U.S.

Pat. No. 3,849,241 to Butin. Meltblown **fibers** are microfibers which may be continuous or discontinuous, are generally smaller than 10 microns in diameter, and are generally self bonding when deposited onto a collecting surface. Meltblown **fibers** used in the present invention are preferably substantially continuous in length. Again, the splitting of **bicomponent** meltblown **fibers** would produce smaller diameter **fibers**.

#### **Brief Summary Text - BSTX (21):**

The term "substantially continuous filaments or **fibers**" refers to filaments or **fibers** prepared by extrusion from a spinnerette, including without limitation spunbonded and meltblown **fibers**, which are not cut from their original length prior to being formed into a nonwoven web or fabric. Substantially continuous filaments or **fibers** may have average lengths ranging from greater than about 15 cm to more than one meter, and up to the length of the web or fabric being formed. The definition of "substantially continuous filaments or **fibers**" includes those which are not cut prior to being formed into a nonwoven web or fabric, but which are later cut when the nonwoven web or fabric is cut.

#### **Brief Summary Text - BSTX (22):**

The term "staple **fibers**" means **fibers** which are natural or cut from a manufactured filament prior to forming into a web, and which have an average length ranging from about 0.1-15 cm, more commonly about 0.2-7 cm.

#### **Brief Summary Text - BSTX (24):**

The term "**bicomponent** filaments or **fibers**" refers to **fibers** which have been formed from at least two polymers extruded from separate extruders but spun together to form one **fiber**. The polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the **bicomponent fibers** and extend continuously along the length of the **bicomponent fibers**. The configuration of such a **bicomponent fiber** may be, for example, a **sheath/core** arrangement wherein one polymer is surrounded by another or may be a side-by-side arrangement or an "islands-in-the-sea" arrangement. **Bicomponent fibers** are taught in U.S. Pat. No. 5,108,820 to Kaneko et al., U.S. Pat. No. 5,336,552 to Strack et al., and U.S. Pat. No. 5,382,400 to Pike et al., each of which is incorporated herein in its entirety by reference. For two **component fibers**, the polymers may be present in ratios of 75/25, 50/50, 25/75 or any other desired ratios. Conventional additives, such as pigments and surfactants, may be incorporated into one or both polymer streams, or applied to the filament surfaces.

#### **Brief Summary Text - BSTX (25):**

The term "splittable **bicomponent** filaments" refers to **bicomponent** filaments, as described above, which split lengthwise into finer filaments of the individual

thermoplastic polymer segments when subjected to a stimulus. The term "controlled splitting" refers to subjecting these **bicomponent** filaments to a controlled stimulus or process which effects the lengthwise splitting at a selected time and place.

#### **Brief Summary Text - BSTX (26):**

The term "pulp **fibers**" refers to **fibers** from natural sources such as woody and non-woody plants. Woody plants include, for example, deciduous and coniferous trees. Non-woody plants include, for instance, cotton, flax, esparto grass, milkweed, straw, jute hemp, and bagasse.

#### **Brief Summary Text - BSTX (27):**

The term "average **fiber** length" refers to a weighted average length of **fibers** determined using a Kajaani **fiber** analyzer Model No. FS-100 available from Kajaani Oy Electronics in Kajaani, Finland. Under the test procedure, a **fiber** sample is treated with a macerating liquid to ensure that no **fiber** bundles or shives are present. Each **fiber** sample is dispersed in hot water and diluted to about a 0.001% concentration. Individual test samples are drawn in approximately 50 to 500 ml portions from the dilute solution and tested using the standard Kajaani **fiber** analysis procedure. The weighted average **fiber** lengths may be expressed by the following equation:  $##EQU1##$  where  $k$ =maximum **fiber** length,  $X_{sub.i}$ =individual **fiber** length,  $n_{sub.i}$ =number of **fibers** having length  $X_{sub.i}$  and  $n$ =total number of **fibers** measured.

#### **Brief Summary Text - BSTX (30):**

The term "incompatible polymers" indicates polymers that do not form a miscible blend, i.e., immiscible, when melt blended. As a desirable embodiment of the present invention, differences in the polymer solubility parameter ( $\delta$ ) may be used to select suitably incompatible polymers. The polymer solubility parameters ( $\delta$ ) of different polymers are well known in the art. A discussion of the solubility parameter is, for example, disclosed in Polymer: Chemistry and Physics of Modern Materials, pages 142-145, by J. M. G. Cowie, International Textbook Co., Ltd., 1973. Desirably, the adjacently disposed polymer **components** of the present conjugate **fiber** have a difference in the solubility parameter of at least about  $0.5 (\text{cal/cm}^3)^{1/2}$ , more desirably at least about  $1 (\text{cal/cm}^3)^{1/2}$ , most desirably at least about  $2 (\text{cal/cm}^3)^{1/2}$ . The upper limit of the solubility parameter difference is not critical for the present invention as long as 1) the filaments do not split prematurely so as to interfere with spinning, and 2) there is adequate control over the splitting.

#### **Brief Summary Text - BSTX (31):**

The term "through-air bonding" or "TAB" means a process of bonding a nonwoven, for example, a **bicomponent fiber** web in which air which is sufficiently hot to melt one of the polymers of which the **fibers** of the web are made is forced through the web. The air velocity is often between 100 and 500 feet per minute and the dwell time may be as long as 6 seconds. The melting and resolidification of the polymer provides the bonding. Through-air bonding has restricted variability and is generally regarded as a second step bonding process. Since TAB requires the melting of at least one **component** to accomplish bonding, it is restricted to webs with two **components such as bicomponent fiber** webs or webs containing an adhesive **fiber** or powder.

#### **Brief Summary Text - BSTX (32):**

The term "thermal point bonding" involves passing a fabric or web of **fibers** to be bonded between a heated calender roll and an anvil roll. The calender roll is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Pat. No. 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen and Pennings or "EHP" bond pattern which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm). The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern which has a bond area of about 16.9%. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds and a wire weave pattern looking as the name suggests, e.g., like a window screen. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. As is well known in the art, the spot bonding holds the laminate layers together as well as imparts integrity to each individual layer by bonding filaments and/or **fibers** within each layer.

#### **Detailed Description Text - DETX (2):**

The present invention is directed to a nonwoven web composite including a matrix of splittable **bicomponent** filaments containing at least a first thermoplastic polymer and a

second thermoplastic polymer incompatible with the first, arranged in distinct zones across a cross-section of each filament. A third **component**, selected from **fibers** and/or particles, is contained within the **bicomponent** filament matrix.

#### **Detailed Description Text - DETX (3):**

The splittable **bicomponent** filaments may be substantially continuous or staple in length. Preferably, the splittable **bicomponent** filaments are substantially continuous. Substantially continuous filaments exhibit better containment of the third **component**, and provide better distribution of liquids, than staple length **fibers**.

#### **Detailed Description Text - DETX (4):**

The splittable **bicomponent** filaments are prepared in such fashion that the distinct segments of incompatible polymers generally extend the length of each filament. Any **bicomponent** configuration which achieves this result may be employed. For instance, the incompatible polymers may be arranged in a side-by-side configuration, or another suitable configuration. Examples of these and other suitable configurations are described in U.S. Pat. No. 5,759,926, issued to Pike et al., the disclosure of which is incorporated by reference.

#### **Detailed Description Text - DETX (5):**

Illustrative examples of particularly desirable pairs of incompatible polymers useful for the splittable **bicomponent** filaments include polyolefin with **polyamide**, e.g., polyethylene with **nylon** 6, polyethylene with **nylon** 6/6, polypropylene with **nylon** 6, polypropylene with **nylon** 6/6, polyethylene with a copolymer of caprolactam and alkylene oxide diamine, and polypropylene with a copolymer of caprolactam and alkylene oxide diamine; polyolefin with polyester, e.g., polyethylene with polyethylene terephthalate, polypropylene with polyethylene terephthalate, polyethylene with polybutylene terephthalate and polypropylene with polybutylene terephthalate; and **polyamide** with polyester, e.g., **nylon** 6 with polyethylene terephthalate, **nylon** 6/6 with polyethylene terephthalate, **nylon** 6 with polybutylene terephthalate, **nylon** 6/6 with polybutylene terephthalate, polyethylene terephthalate with a copolymer of caprolactam and alkylene oxide diamine, and polybutylene terephthalate with a copolymer of caprolactam and alkylene oxide diamine. Other incompatible polymers may also be employed, as well as blends thereof. For instance, the first polymer A may be a single polymer or multi-polymer blend, and the second polymer B may be a different single polymer or multi-**component** blend, so long as the polymer segments A and B are incompatible with each other. Additives, such as pigments and hydrophilic modifiers, may be incorporated into one or both polymers, or applied to the filament surfaces.

#### **Detailed Description Text - DETX (6):**



Generally, the splittable **bicomponent** thermoplastic filaments contain about 10-90% by weight of each of the first and second incompatible polymers. Preferably, each splittable filament includes about 25-75% by weight of each incompatible polymer, more preferably about 40-60% by weight of each incompatible polymer. When more than two incompatible polymer segments are present in the **bicomponent** filaments, the preferred weight **percentages** of each segment will be lower. The splittable **bicomponent** filaments may be produced using a spunbonding process, a meltblowing process, an air laying process, or another suitable process. The **bicomponent** filaments may have an average diameter of about 1-75 microns, preferably about 1-50 microns, more preferably about 1-30 microns, before splitting.

#### **Detailed Description Text - DETX (7):**

In one embodiment of the invention, the splittable **bicomponent** filaments can be characterized in that each splittable filament contains at least two incompatible **component** polymers and at least one of the **component** polymers is hydrophilic. In accordance with the present invention, the hydrophilic **component** polymer is a naturally hydrophilic polymer or a hydrophilically modified polymer. The term "hydrophilic" as used herein indicates affinity for water. The hydrophilicity of the hydrophilic **component** polymer can be measured in accordance with the ASTM D724-89 contact angle testing procedure on a film produced by melt casting the polymer at the temperature of the spin pack that is used to produce the conjugate **fibers**. Desirably, the hydrophilic polymer **component** has an initial contact angle less than about 90.degree., more desirably equal to or less than about 75.degree., even more desirably equal to or less than about 60.degree., most desirably equal to or less than about 50.degree.. The term "initial contact angle" as used herein indicates a contact angle measurement made within about 5 seconds of the application of water drops on a test film specimen. The other polymer can be hydrophobic, as indicated by a contact angle of at least 90.degree..

#### **Detailed Description Text - DETX (8):**

Naturally hydrophilic polymers suitable for the present invention include thermoplastic polymers having the above-specified hydrophilicity. Such polymers include copolymers of caprolactam and alkylene oxide diamine, e.g., Hydrofil.RTM., which are commercially available from Allied Signal Inc.; thermoplastic copolymers of poly(oxyethkylene) and polyurethane, **polyamide**, polyester or polyurea, e.g., absorbent thermoplastic polymers disclosed in U.S. Pat. No. 4,767,825 to Pazos et al.; ethylene vinyl alcohol copolymers; and the like. U.S. Pat. No. 4,767,825 in its entirety is herein incorporated by reference.

#### **Detailed Description Text - DETX (9):**

Hydrophilically modifiable polymers suitable for the present invention include polyolefins, polyesters, **polyamides**, polycarbonates and copolymers and blends thereof. Suitable polyolefins include polyethylene, e.g., high density polyethylene, medium density polyethylene, low density polyethylene and linear low density polyethylene; polypropylene, e.g., isotactic polypropylene, syndiotactic polypropylene, blends of isotactic polypropylene and atactic polypropylene, and blends thereof; polybutylene, e.g., poly(1-butene) and poly(2-butene); polypentene, e.g., poly(1-pentene) and poly(2-pentene); poly(3-methyl-1-pentene); poly(4-methyl-1-pentene); and copolymers and blends thereof. Suitable copolymers include random and block copolymers prepared from two or more different unsaturated olefin monomers, such as ethylene/propylene and ethylene/butylene copolymers. Suitable **polyamides** include **nylon 6**, **nylon 6/6**, **nylon 4/6**, **nylon 11**, **nylon 12**, **nylon 6/10**, **nylon 6/12**, **nylon 12/12**, and the like, as well as blends and copolymers thereof. Suitable polyesters include polyethylene terephthalate, polybutylene terephthalate, polytetramethylene terephthalate, polycyclohexylene-1,4-dimethylene terephthalate, and isophthalate copolymers thereof, as well as blends thereof.

#### **Detailed Description Text - DETX (10):**

In accordance with the present invention, when a hydrophobic or insufficiently hydrophilic polymer is used as the hydrophilic **component** of the splittable **bicomponent fiber**, the polymer must be hydrophilically or wettably modified. One useful means for modifying the polymer is adding a hydrophilic modifying agent or hydrophilic modifier that renders the polymer hydrophilic. Suitable hydrophilic modifiers include various surfactants. Depending on the final use of the split **fiber** material, the surfactants can be fugitive or nonfugitive. Fugitive surfactants, i.e., surfactants that wash off from the **fiber** surface, are suitable if the split **fibers** are used in single exposure applications or applications in which nonwetable or hydrophobic properties are desired, and nonfugitive surfactants, i.e., surfactants that permanently or semipermanently adhere to the **fiber** surface, are suitable if the split **fibers** are used in applications in which more durably wettable or hydrophilic properties are desired.

#### **Detailed Description Text - DETX (11):**

In addition, particularly suitable internally added surfactants are selected to have a low compatibility with the polymer of the hydrophilic **component of the fiber** since such surfactants readily migrate to the surface of the **fiber** during the **fiber** spinning process. When a surfactant having a slow migration characteristic is utilized, the **fibers** may need to be heat treated or annealed to facilitate the migration of the surfactant to the surface. Such heat treatment is known in the art as a "blooming" process. Illustrative examples of suitable surfactants include silicon based surfactants, e.g., polyalkylene-oxide modified polydimethyl siloxane, fluoroaliphatic surfactants, e.g., perfluoroalkyl polyalkylene

oxides; and other surfactants, e.g., actylphenoxypolyethoxy ethanol nonionic surfactants, alkylaryl polyether alcohols, and polyethylene oxides.

#### **Detailed Description Text - DETX (13):**

The amount of surfactants required and the hydrophilicity of modified fibers for each application will vary depending on the type of surfactant and the type of polymer used. In general, fibers containing more hydrophilic or hydrophilically modified polymer components result in more spontaneous splitting. Consequently, a high level of a surfactant can be added to the polymer composition of the conjugate fibers provided that the surfactant level is not too high as to adversely affect the processibility of the polymer composition. Typically, the amount of the surfactant suitable for the present fiber composition is in the range of from about 0.1% to about 5%, desirably from about 0.3% to about 4%, by weight based on the weight of the polymer composition. The surfactant is thoroughly blended with the polymer composition before the composition is processed into fibers. For example, when a melt extrusion process for producing fibers is utilized, the surfactant is blended and melt extruded with the polymer compositions in extruders and then spun into fibers.

#### **Detailed Description Text - DETX (14):**

In accordance with the present invention, additional polymers for the bicomponent filaments may be present in the filaments so that, for instance, the filaments may split into three or more components instead of two. Suitable additional polymers include the above-illustrated hydrophilic polymers, hydrophobic polymers and modified hydrophobic polymers provided that they are incompatible with the other component polymers of the filaments, to facilitate splitting.

#### **Detailed Description Text - DETX (15):**

A wide variety of third component fibers and/or particles may be incorporated into the splittable bicomponent filament matrix, to make the improved nonwoven web composite of the invention. The nonwoven web composite includes about 5-97% by weight of the third component selected from fibers, particles, and combinations thereof, and about 3-95% by weight of the splittable bicomponent thermoplastic filaments. Preferably, the nonwoven web composite includes about 35-95% by weight of the third component and about 5-65% by weight of the splittable bicomponent thermoplastic filaments. More preferably, the nonwoven web composite includes about 50-95% by weight of the third component and about 5-50% by weight of the splittable bicomponent thermoplastic filaments.

#### **Detailed Description Text - DETX (16):**

**Fibers** which can be employed as the third **component** include, without limitation, absorbent **fibers** such as rayon staple **fibers**, cotton **fibers**, natural cellulose **fibers** such as wood pulp **fibers** and cotton linters, other pulp **fibers**, superabsorbents that are in **fiber** form, and combinations of the foregoing. Other useful **fibers** include fiberized feathers; for example, fiberized poultry feathers such as fiberized chicken feathers. Particles can be employed as the third **component** alone or in combination with **fibers**. Examples of useful particulate materials include, without limitation, activated charcoal, clays, starches, superabsorbents in particle form, and odor absorbents such as zeolites, yucca chitosan, and molecular sieve materials.

#### **Detailed Description Text - DETX (17):**

The splittable thermoplastic **bicomponent** nonwoven filaments may be combined with the third **component** materials using processes well known in the art. For example, a coform process may be employed, in which at least one meltblown diehead is arranged near a chute through which other materials are added while the web is forming. Coform processes are described in U.S. Pat. Nos. 4,818,464 to Lau and 4,100,324 to Anderson et al., the disclosures of which are incorporated by reference. The splittable thermoplastic **bicomponent** filaments and third **component** materials may also be combined using hydraulic entangling or mechanical entangling. A hydraulic entangling process is described in U.S. Pat. No. 3,485,706 to Evans, the disclosure of which is incorporated by reference. After combining the ingredients, the composite nonwoven web may be bonded together using the through-air bonding or thermal point bonding techniques described above, to provide a coherent high integrity structure.

#### **Detailed Description Text - DETX (18):**

Pulp **fibers** are especially useful as a third **component** when the composite nonwoven web is employed in an absorbent article. Preferred pulp **fibers** include cellulose pulp **fibers**. The pulp **fibers** may be any high average **fiber** length pulp, low average **fiber** length pulp, or mixtures of them.

#### **Detailed Description Text - DETX (19):**

The term "high average **fiber** length pulp" refers to pulp that contains a relatively small amount of short **fibers** and non-**fiber** particles. High **fiber** length pulps typically have an average **fiber** length greater than about 1.5 mm, preferably about 1.5-6 mm, as determined by an optical **fiber** analyzer, such as the Kajaani tester referenced above. Sources generally include non-secondary (virgin) **fibers** as well as secondary **fiber** pulp which has been screened. Examples of high average **fiber** length pulps include bleached and unbleached virgin softwood **fiber** pulps.

#### **Detailed Description Text - DETX (20):**

The term "low average fiber length pulp" refers to pulp that contains a significant amount of short fibers and non -fiber particles. Low average fiber length pulps have an average fiber length less than about 1.5 mm, preferably about 0.7-1.2 mm, as determined by an optical fiber analyzer such as the Kajaani tester referenced above. Examples of low fiber length pulps include virgin hardwood pulp, as well as secondary fiber pulp from sources such as office waste, newsprint, and paperboard scrap.

#### **Detailed Description Text - DETX (21):**

Examples of high average fiber length wood pulps include those available from the U.S. Alliance Coosa Pines Corporation under the trade designations Longlac 19, Coosa River 56, and Coosa River 57. The low average fiber length pulps may include certain virgin hardwood pulp and secondary (i.e., recycled) fiber pulp from sources including newsprint, reclaimed paperboard, and office waste. Mixtures of high average fiber length and low average fiber length pulps may contain a predominance of low average fiber length pulps. For example, mixtures may contain more than about 50% by weight low-average fiber length pulp and less than about 50% by weight high-average fiber length pulp. One exemplary mixture contains about 75% by weight low-average fiber length pulp and about 25% by weight high-average fiber length pulp.

#### **Detailed Description Text - DETX (22):**

The pulp fibers may be unrefined or may be beaten to various degrees of refinement. Crosslinking agents and/or hydrating agents may also be added to the pulp mixture. Debonding agents may be added to reduce the degree of hydrogen bonding if a very open or loose nonwoven pulp fiber web is desired. One exemplary debonding agent is available from the Quaker Chemical Company, Conshohocken, Pa., under the trade designation Quaker<sup>®</sup>2008. The addition of certain debonding agents in the amount of, for example, 1-4% by weight of the composite, may reduce the measured static and dynamic coefficients of friction and improve the abrasion resistance of the thermoplastic continuous polymer filaments. The debonding agents act as lubricants or friction reducers. Debonded pulp fibers are commercially available from Weyerhaeuser Corp. under the designation NB405.

#### **Detailed Description Text - DETX (23):**

In one highly advantageous embodiment, the third component includes a combination of pulp fibers and superabsorbent particles and/or fibers, to form a highly absorbent nonwoven web composite. The term "superabsorbent" or "superabsorbent material" refers to a water-swellaable, water-insoluble organic or inorganic material capable, under the most favorable conditions, of absorbing at least about 20 times its weight and, more desirably, at least about 30 times its weight in an aqueous solution containing 0.9 weight percent sodium chloride.

#### **Detailed Description Text - DETX (26):**

Superabsorbent materials may be xerogels which form hydrogels when wetted. The term "hydrogel," however, has commonly been used to also refer to both the wetted and unwetted forms of the superabsorbent polymer material. The superabsorbent materials can be in many forms such as flakes, powders, particulates, fibers, continuous fibers, networks, solution spun filaments and webs. Particles can be of any desired shape, for example, spiral or semi-spiral, cubic, rod-like, polyhedral, etc. Needles, flakes, fibers, and combinations may also be used.

#### **Detailed Description Text - DETX (28):**

In a preferred embodiment, the third component is combined with the thermoplastic bicomponent filaments before any splitting of the filaments is induced. After combining the ingredients together, the bicomponent filaments are split into finer filaments which better entrap, ensnare and contain the third component within the thermoplastic filament matrix. The splitting of the bicomponent filaments may then be effected using a variety of known techniques. When a hydrophilic material is used as one of the incompatible polymers, as described above, splitting may be accomplished without mechanical agitation using an aqueous split-inducing medium. A hot aqueous split-inducing medium is described in the above-identified U.S. Pat. No. 5,759,926.

#### **Detailed Description Text - DETX (29):**

Aqueous split-inducing media suitable for the invention include unheated as well as hot water. A desirable split-inducing media is hot water having a temperature of at least about 60.degree. C., more desirably a temperature between about 65.degree. C. and 100.degree. C. Additionally, suitable media are steam and mixtures of steam and air that have a temperature higher than 60.degree. C. but lower than the melting point of the lowest melting polymer of the bicomponent fiber in order to prevent inadvertent melting of the polymer components during the fiber splitting process. When an air and steam mixture medium is utilized, the temperature of the air, which is mixed with steam, can be adjusted to change the temperature of the split-inducing medium. For example, the temperature of the air can be elevated to further increase the temperature of the steam-air mixture.

#### **Detailed Description Text - DETX (30):**

In a preferred embodiment, the splittable conjugate fibers split in a time frame equal to or less than about 30 seconds; desirably equal to or less than about 10 seconds; more desirably equal to or less than 5 seconds; most desirably less than equal to or less than 1 seconds, e.g., nearly instantaneous, when contacted with the split-inducing medium. In addition, at least about 25%, desirably at least about 50%, more desirably at least about

75%, most desirably at least about 95% and up to 100% of the conjugate fiber splits with the present fiber splitting process.

#### **Detailed Description Text - DETX (31):**

The aqueous fiber splitting process provides various ways to control the extent of fiber splitting. For example, the hydrophilicity of the components for the bicomponent fibers can be adjusted, the temperature of the aqueous split-inducing medium can be adjusted, or the duration of exposure to the split-inducing medium can be controlled to regulate the extent of fiber splitting. The hydrophilicity of the compositions can be simply adjusted by selecting polymers with varying levels of inherent hydrophilicity and by varying the level of addition and/or changing the type of the hydrophilic modifier when such a modifier is used.

#### **Detailed Description Text - DETX (32):**

The splittable bicomponent fibers need not be conventional round fibers. Other useful fiber shapes include rectangular, oval and multilobal shapes and the like. Thin rectangular fibers and multilobal fibers are particularly suitable for the present invention. The thin rectangular or multilobal shape of the bicomponent fiber provides a higher surface area that can be exposed to the split-inducing medium, better facilitating splitting of the fiber. Consequently, compared to conventional round fibers, the rectangular or multilobal bicomponent fibers split more easily when subjected to the split-inducing medium.

#### **Detailed Description Text - DETX (33):**

The splittable fibers may be crimped or uncrimped. Crimped splittable bicomponent fibers of the present invention are highly useful for producing lofty woven and nonwoven fabrics since the fine fibers split from the bicomponent fibers largely retain the crimps of the bicomponent fibers and the crimps increase the bulk or loft of the fabric. Such lofty fine fiber fabric of the present invention exhibits cloth-like textural properties, e.g., softness, drapability and hand, as well as desirable strength properties of a fabric containing highly oriented fibers. As for uncrimped split fiber fabrics, such fabrics provide improved uniform fiber coverage and strength properties as well as improved hand and texture.

#### **Detailed Description Text - DETX (34):**

An elastic polymer may be combined with an inelastic polymer in side-by-side splittable bicomponent filaments to produce splittable bicomponent filaments having a tendency to crimp. The crimped bicomponent filaments may be in the form of meltblown microfibers, which are relatively fine and flexible, to help entangle the third

**component**. The **crimped bicomponent** filaments may also be spunbond filaments, for added loft and resilience. **Crimped** splittable **bicomponent** filaments can be used with or without other thermoplastic filaments in a nonwoven web to provide enhanced bulk and lower web density.

#### **Detailed Description Text - DETX (35):**

Exemplary elastic materials, useful for producing splittable **crimped bicomponent** filaments, include without limitation the following. These materials may be extruded along with a second (incompatible) polymer which is a) inelastic, and b) preferably has hydrophilic properties, for the reasons explained above.

#### **Detailed Description Text - DETX (37):**

In addition to combinations of relatively elastic and relatively inelastic polymers, other polymer combinations can be employed to achieve crimping. For instance, crimping may be achieved using combinations of relatively heat shrinkable polymers (polymers whose filaments shrink upon secondary heating to a temperature below the melting peak) with relatively non-heat shrinkable polymers in the splittable **bicomponent** thermoplastic filaments. Exemplary heat shrinkable polymers include without limitation the following:

#### **Detailed Description Text - DETX (39):**

Various other improvements and embodiments are also considered to be within the scope of the invention. In another embodiment, the splittable **bicomponent** thermoplastic filaments may be combined with other thermoplastic filaments in addition to the third **component**. For instance, the splittable **bicomponent** thermoplastic filaments may include a mixture of **bicomponent** spunbond filaments and **bicomponent** meltblown filaments. In this embodiment, the spunbond filaments impart greater strength and the meltblown filaments are more effective in capturing and entangling the pulp **fibers**. In still another embodiment, the splittable **bicomponent** filaments may be spunbond and mixed with meltblown **fibers** (not necessarily **bicomponent**) which have a relatively low melting point. The composite web may thus be formed by combining three or more streams of **bicomponent** spunbond filaments, lower melting meltblown filaments and third **component** (particles and/or **fibers**). The meltblown filaments may still be hot and tacky when the third **component** particles and/or **fibers** are introduced, and may fuse with the third **component** to help consolidate the structure. Meltblown microfibers, which typically have diameters much smaller than spunbond **fibers**, may in effect serve as a binder or adhesive for the third **component** particles and/or **fibers**.

#### **Detailed Description Text - DETX (40):**



The improved nonwoven composite of the invention can be used in a wide variety of absorbent products including, without limitation, personal care absorbent articles. Personal care absorbent articles include diapers, training pants, swim wear, absorbent underpants, baby wipes, adult incontinence products, feminine hygiene products, and the like. The absorbent nonwoven composite is particularly useful in diapers, wherein the splittable **bicomponent** filaments contribute softness, bulk and durability, as well as excellent retention of the third **component**, which may include a combination of pulp **fibers** and superabsorbent. Other absorbent articles which may utilize the nonwoven composite of the invention include without limitation, absorbent medical products, including underpads, bandages, absorbent drapes, and medical wipes which contain alcohol and/or other disinfectants.

#### **Claims Text - CLTX (1):**

1. A nonwoven web composite, comprising: a matrix including filaments formed by splitting **bicomponent** thermoplastic filaments, the **bicomponent** filaments including a first thermoplastic polymer and a second thermoplastic polymer arranged in distinct zones across a cross-section of individual **bicomponent** filaments; the first and second thermoplastic polymers being incompatible with each other and responsive to a nonmechanical stimulus to induce separation from each other; and a third **component** contained within the matrix, the third **component** selected from the group consisting of **fibers**, particles, and combinations thereof.

#### **Claims Text - CLTX (3):**

3. The nonwoven web composite of claim 1, wherein the **bicomponent** thermoplastic filaments comprise substantially continuous filaments.

#### **Claims Text - CLTX (4):**

4. The nonwoven web composite of claim 1, wherein the **bicomponent** thermoplastic filaments comprise spunbond filaments.

#### **Claims Text - CLTX (5):**

5. The nonwoven web composite of claim 1, wherein the **bicomponent** thermoplastic filaments comprise meltblown filaments.

#### **Claims Text - CLTX (7):**

7. The nonwoven web composite of claim 1, wherein the first thermoplastic polymer comprises a polyolefin and the second thermoplastic polymer comprises a **polyamide**.

**Claims Text - CLTX (9):**

9. The nonwoven web composite of claim 1, wherein the first thermoplastic polymer comprises a polyamide and the second thermoplastic polymer comprises a polyester.

**Claims Text - CLTX (11):**

11. The nonwoven web composite of claim 1, wherein the bicomponent thermoplastic filaments comprise crimped filaments.

**Claims Text - CLTX (15):**

15. The nonwoven web composite of claim 1, wherein the third component comprises absorbent fibers selected from the group consisting of rayon fibers, cotton fibers, pulp fibers, superabsorbent fibers, fiberized feathers, and combinations thereof.

**Claims Text - CLTX (16):**

16. The nonwoven web composite of claim 1, wherein the third component comprises particles selected from the group consisting of charcoal, clays, starches, superabsorbent particles, odor absorbents, and combinations thereof.

**Claims Text - CLTX (17):**

17. The nonwoven web composite of claim 1, wherein the third component comprises pulp fibers and a superabsorbent.

**Claims Text - CLTX (18):**

18. The nonwoven web composite of claim 1, comprising about 3-95% by weight of the filament matrix and about 5-97% by weight of the third component.

**Claims Text - CLTX (19):**

19. The nonwoven web composite of claim 1, comprising about 5-65% by weight of the filament matrix and about 35-95% by weight of the third component.

**Claims Text - CLTX (20):**

20. The nonwoven web composite of claim 1, comprising about 5-50% by weight of the filament matrix and about 50-95% by weight of the third component.

**Claims Text - CLTX (21):**

21. A nonwoven web composite, comprising: a matrix including filaments formed by splitting **bicomponent** thermoplastic filaments, the **bicomponent** filaments including a first thermoplastic polymer and a second thermoplastic polymer arranged in distinct zones across a cross-section of individual **bicomponent** filaments; the first and second thermoplastic polymers being incompatible with each other and responsive to a nonmechanical aqueous stimulus to induce separation from each other; and a third **component** contained within the matrix, the third **component** selected from the group consisting of **fibers**, particles, and combinations thereof.

**Claims Text - CLTX (23):**

23. A nonwoven web composite according to claim 22, further comprising: the third **component** being an absorbent material.

**Claims Text - CLTX (24):**

24. A nonwoven web composite according to claim 21, further comprising: the third **component** being an absorbent material.